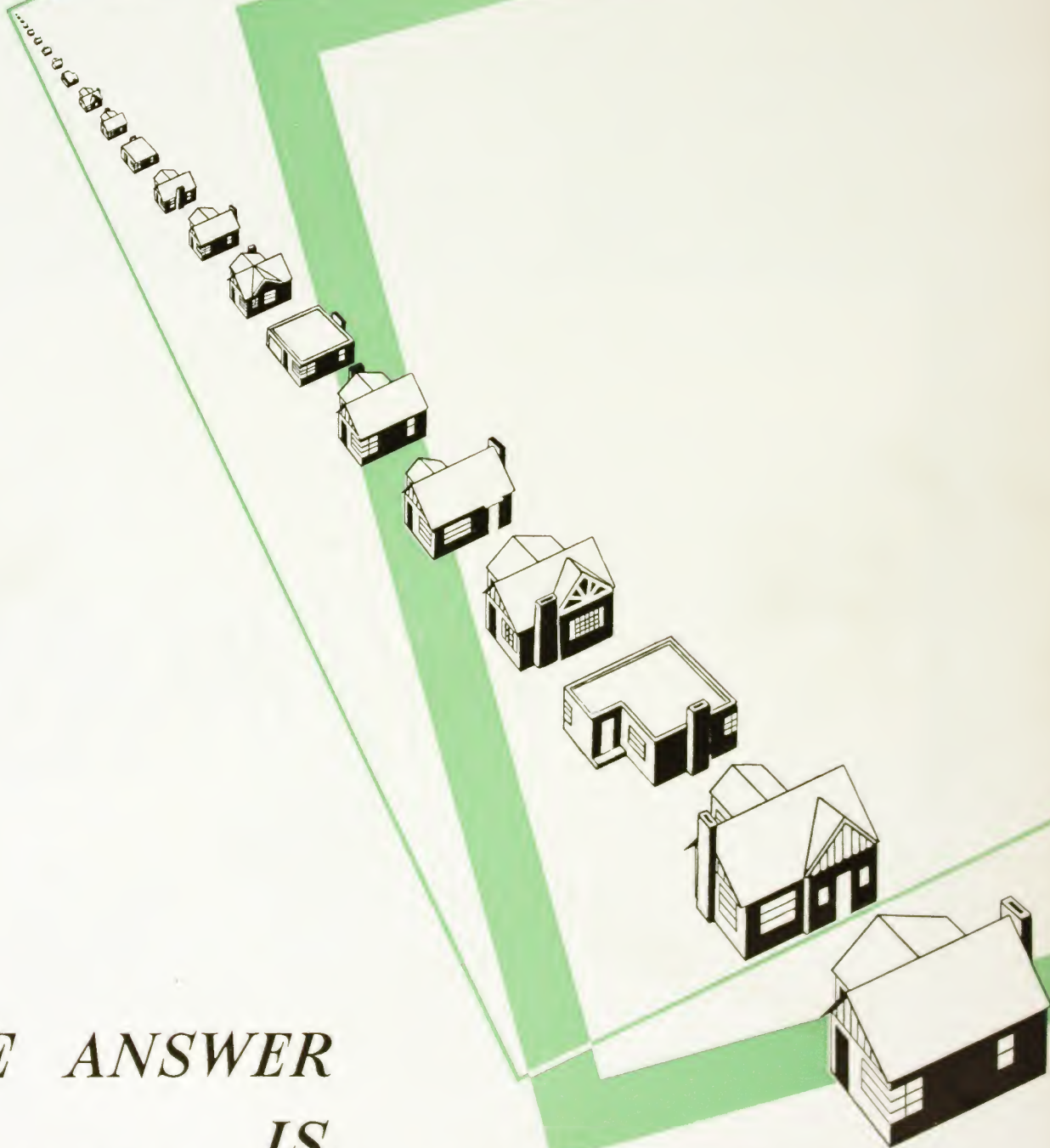


HOW TO BUILD A HOUSE

FAST?



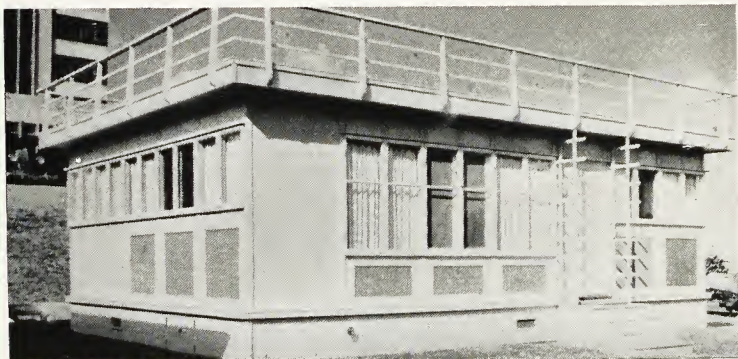
THE ANSWER

IS

PREFABRICATION



Defense Housing Project, Bremerton, Washington. Duplex all-plywood units, prefabricated at rate of four buildings per day. Walls and partitions were erected at rate of 16 lineal feet per man-hour. The entire 300 housing units were erected in two months' time, providing badly needed shelter for navy yard crews. Courtesy, I. F. Laucks, Inc. (Speedwall Co.), Seattle, Wash.



Original Prefabricated Plywood house built at U. S. Forest Products Laboratory, Madison, Wisconsin, in 1935, to demonstrate stress-covered principle with prefabricated plywood panels for walls, roof and floor. Courtesy, U. S. Forest Products Laboratory.



The Modern Squad tent prefabricated for Uncle Sam's soldiers. Cool and airy or warm and cozy, to fit the weather. Flaps raised are of $\frac{1}{2}$ " DFPA Exterior plywood. Partitions below screens are $\frac{1}{4}$ " Exterior plywood. Roof is $\frac{1}{4}$ " Exterior plywood. Floor is $\frac{1}{2}$ " Exterior plywood. Courtesy, Houston Ready-Cut House Co., Inc.

terior or "waterproof" type of Douglas fir plywood for permanent outside use.

Third was the prefabricated house built by engineers of the U. S. Forest Products Laboratory at Madison, Wisconsin, in 1935. Many types of prefabricated houses with various materials had been tried already, with but little progress toward the desired goal. When, however, the Government engineers actually built a practical prefabricated house, erecting it in a few hours, attention was immediately focused on the methods and the materials. That demonstration house was the spark that fired the imagination of scores of architects, engineers and builders and started them on the road to prefabrication. Plywood had been demonstrated to be the almost ideal material for which they had been waiting.

The Douglas Fir Plywood Association, in the Spring of 1940, published its "DFP Construction Manual," illustrating the ease and simplicity of prefabricating complete plywood walls, partitions, ceilings, and other elements. The Manual was designed primarily for the local builder and his lumber dealer, but was

used also by the prefabricator seeking larger regional markets.

In 1941, when the cry came for defense housing, the prefabricated house industry was ready.

Today, many thousands of such houses and other buildings are already in use, and hundreds of more are in process. Every geographical area in the United States can boast of plywood housing projects.

ADVANTAGES:

Prefabrication has certain outstanding advantages over conventional methods of house building.

1. Shop work can be systematized, is much faster than field work. There are no delays from bad weather.

2. Greater speed minimizes overhead.

3. Greater accuracy and control are obtained.

4. Glued construction, far superior to nailing, is made possible.

5. Foundation work can be carried on simultaneously with shop assembly.

6. Field erection is accomplished in a few hours, usually only four or five.

7. The result is generally an overall economy in favor of the Prefabricated House.



Another plywood housing project, planned by Farm Security Administration engineers and built under their supervision, to provide living quarters for Bremerton Navy Yard workers. Walls and partitions were prefabricated by an established company and erected in record time by the MacDonald Construction Company of Tacoma, Washington.

Courtesy, I. F. Laucks, Inc. (Speedwall Co.)

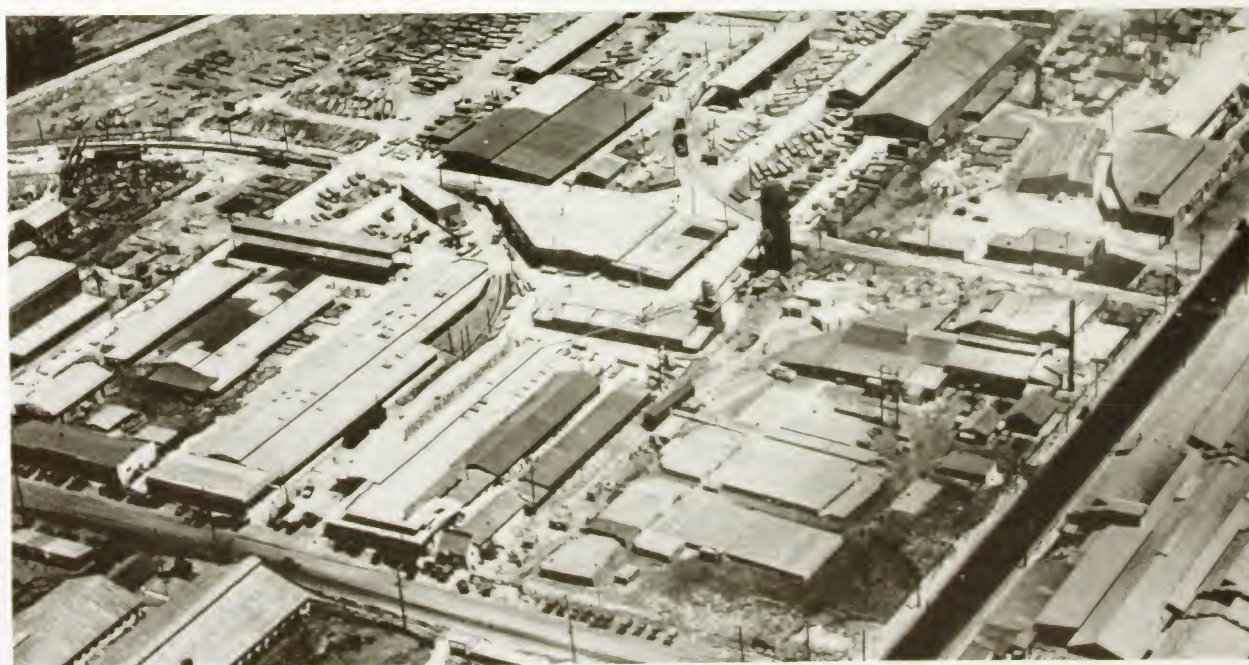


Using hot plate press to joint plywood panels in a prefabricated plywood house factory. Panels are butted and glued to a longitudinal plywood strip about 2½" wide, that is nailed to the stud at the joint.

Courtesy, GBH-Way Homes, Inc., Walnut, Illinois.

Twenty-two acres of manufacturing facilities is the home of a thirty-three year old plant that has produced prefabricated materials for more than 38,000 homes in sections of the United States and the world.

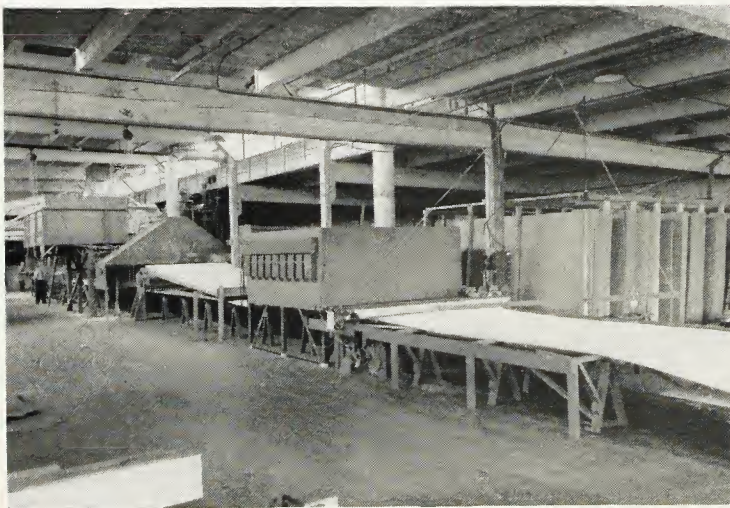
Courtesy, Pacific System Homes, Inc.





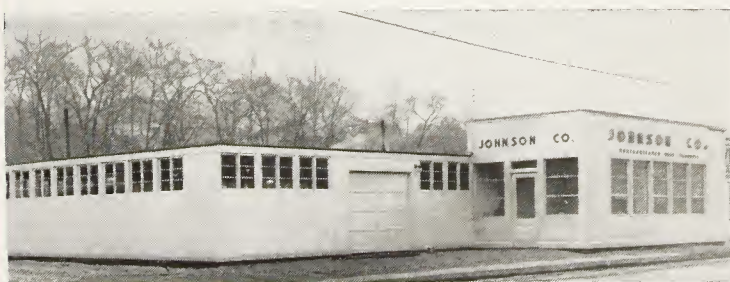
Attractive living room, with Douglas fir plywood walls and ceilings, finished in natural warm tones with coat of slightly pigmented sealer, shellac, and varnish. Simple, butted panel joints, accurately machined and fitted, are placed symmetrically at each side of all the openings.

Courtesy, National Homes Corporation.



Jointed Walls and Ceilings. Plywood panels 8' by 4' are scarf-jointed along the 8' side to form a continuous panel 8' wide by any desired length. A cotton fabric is also applied to one face in this process.

Courtesy, I. F. Laucks, Inc. (Speedwall Co.)



A new Prefabricating plant with a capacity of 20 houses per month. The building was constructed with prefabricated plywood wall units.

Courtesy, Johnson Co., Sharon, Pa.

DESIGN:

Prefabrication methods permit a wide variation in design and type of house.

Even one standard design may be varied in a number of ways through reversing the floor plan, changing entrance and porch details, or garage, use of mouldings, or merely through differences in color of paint, roofing, blinds or shutters and the like.

PLYWOOD IDEAL PREFABRICATING MATERIAL:

Douglas fir plywood over a skeleton frame has become the standard material with prefabricators from coast to coast.

Plywood's pre-eminence in this field is due to its unusual and well-established structural properties, its large panel size, and the ease with which attractive, yet economical finishes may be applied.

Structurally, plywood is an extremely tough, durable, yet light weight panel that is virtually "kick-proof" and "scuff-proof."

Tests at the U. S. Forest Products Laboratory have proved the superior rigidity imparted to a frame or wall when it is covered with plywood. Gluing plywood to the framing is tremendously effective, because it creates a "stress-covered" panel, famous in airplane construction.

Such plywood units possess remarkable strength and stiffness, yet are so light as to be easily portable.

Plywood has numerous other proved advantages as a wall covering, sub-floor, and roof sheathing. It is quickly applied, in shop or field, at substantial savings in time.

Plywood houses are air-tight, warm, and comfortable. Drafts are eliminated and heating costs are lowered.

Plywood walls have excellent acoustical properties. Tests by Sabine and the Bureau of Standards show plywood to be about five times more effective than ordinary hardwall construction in deadening sound, and about



One type of lumber frame, with plywood faces, before assembly into panel unit. Assembly work is actually performed on a table jig. Then panels are glued to frames.
Courtesy, Plywood Structures, Inc.

equal to plaster or pulp boards in sound insulation.

Condensation is no problem with plywood walls. Two coats of asphalt paint on the back of a plywood panel, or a layer of glossy surfaced asphalt building paper makes an effective and economical Vapor Barrier, according to the U. S. Forest Products Laboratories.

Finishing of plywood may be "natural" or colored stains, varnishes, or paints of various types. Wallpaper and felt are popular as are patented materials like Sanitas.

Finally, Douglas fir plywood is available in an exterior type for permanent outside use, and a moisture-resistant type for sheathing, sub-flooring, and interior paneling, with standard grades to fit the specific purpose.

About 150 million square feet of Douglas fir plywood is being manufactured each month and with several new mills under construction, still larger quantities will be produced. The plywood industry has cooperated to the utmost in providing material for defense housing and all other emergency items for which plywood was demanded. Nevertheless, large volumes are going into regular construction work so that there is no need to substitute inferior materials when Douglas fir plywood is wanted.



Framing lumber is cut to standard size and shape, ready for inserting in table jigs and covering with plywood. This exactness makes walls true.
Courtesy, Green's Ready-Built Homes.



Wall panel assembly, showing cross headers. Table jigs permit quick, accurate placement of framing pieces and speeds all nailing and gluing.
Courtesy, National Homes Corporation.



Table jig in which the skeleton framing for a window panel is being nailed together. The narrow cross strips with gaps between are the guides. The wider pieces, on edge, are the framing members, all of which have not yet been placed in the guides to complete framework.
Courtesy, Plywood Structures, Inc.



The numerous jigs for assembling wall panels permit rapid production using assembly-line techniques.
Courtesy, Green's Ready-Built Homes.

PREFABRICATON METHODS:

In general, three types of prefabricated wall units, all 8' high, are used: (a) Full wall size units containing door and window openings, (b) 4'x8' units, which include stock units for plain wall, door, and window panels, and also filler panels to fit the particular dimensions required, and (c) Plain wall units extending between openings, and from edge of opening to house corner. Window and door frames are inserted between these solid wall units.

Such prefabricated panels consist of a lumber frame with Douglas fir plywood panels fastened to each side, with either nails or glue.

Outside wall panels may have the outer face of 3/8" or 1/2" exterior plywood applied directly to the studs, or else have 5/16" plyscord sheathing on the studs.



Inserting blanket insulation cut to size, with vapor resistant backing. The workmen are using hammer clips to speed up this operation.
Courtesy, National Homes, Inc.



Illustrating the use of a hot plate press to glue plywood to the lumber framework. The plywood has already been factory jointed to form long sheets, which are being glued to each side of the wall or partition unit.
Courtesy, I. F. Laucks, Inc. (Speedwall Co.)

and be covered later with exterior plywood, siding, or other material. In cold climates, suitable insulation and vapor barrier may be inserted. The inside face of wall panels is generally covered with 1/4" (or 5/8") Plywall, to be finished as desired.

Interior partitions are similarly constructed except that both faces are lined with Plywall.

Wall and partition units are fabricated by assembling pre-cut studs, plates and headers in table jigs. Then plywood is glued or nailed to one side and unit is turned over to receive plywood on the opposite face.

Roof panels for hipped roofs may consist of "Plyscord" sheathing nailed to top of rafters. In some instances, roof shingles have been applied to panels in the shop. Joints between roof panels are then made weathertight by inserting shingles over the joint.



A portable electric saw is a necessary tool in the modern prefabrication plant. Note framing details, with slot in near stud (immediate foreground) for inserting plywood splines to connect adjoining panel section.

Courtesy, GBH-Way Homes, Inc., Walnut, Ill.



Demountability is a recent Government requirement to which prefabricated houses are readily adapted. Here plywood floor panels are being built in units at the job for ease and economy in removing to some future scene of urgent industrial activity. The high degree of rigidity imparted to a panel when faced with plywood permits frequent handling and shipping without damage, an important feature of demountability.

Courtesy, Plywood Structures.



In foreground, metal sash are being inserted in wall units. Note how plywood overlaps framing in order to permit insertion of triangular splined connection along sides. Top and bottom are inserted plates.

Courtesy, E. K. Wood Lbr. Co. (Bates Prefabricated System).

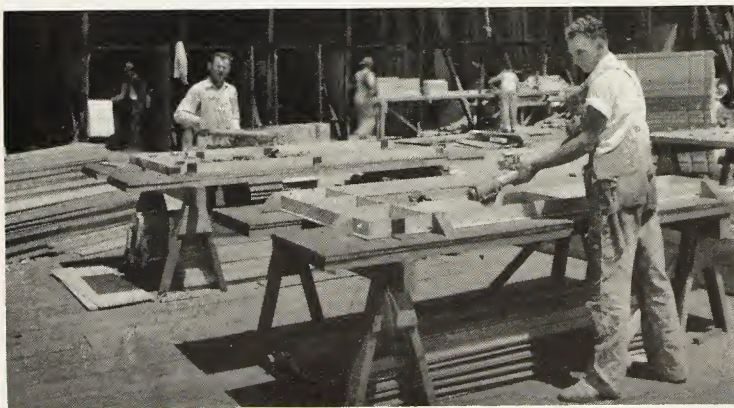


Table jigs, with guides are employed for laying up and nailing together the studs, plates, headers, etc., into framing assemblies. The next step, as shown above, is to apply the glue to all exposed surfaces. This plant utilizes "glue guns," which have proved faster and more efficient than brushing. Plywood will be placed over the glued surface and nailed on 5" centers to provide necessary pressure for proper adhesion. When plywood has been glued to both sides, panels are allowed to set. The result is a strong, rigid, light-weight, stress-covered plywood panel unit.

Courtesy, E. K. Wood Lbr. Co. (Bates Prefabricated System)



Batt-insulation being installed in wall units for Bremerton Housing Project, Puget Sound, Washington. Plywood-lined walls are warm and air-tight, but when added insulation is used such walls are entirely suitable for the most rigorous of climates.

Courtesy, I. F. Laucks (Speedwall Co.)



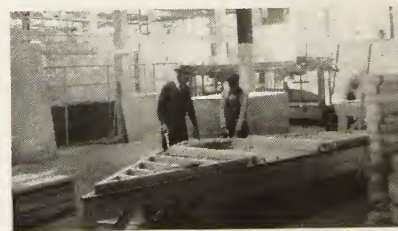
Spray booth at right for priming wall panels which are moved along roller track and overhead trolley. Note stack of prefabricated ceiling sections at left in background.

Courtesy, Pease-Way Homes.



Prefabricating ceiling sections in accordance with DFP Construction Method. Ribs, 1" x 5", are laid, 16" apart, in a large jig. Plywood panels are nailed to these ribs with a special hot pressed glued joint where 4'x8' panels meet. Ceiling sections are full room length, but are field jointed at 8' lengths in systems employing this theory.

Courtesy, Pease-Way Homes.



Interior of large prefabricating factory. Gable end, with window framing, is being assembled on bench. In background may be seen sections on the assembly line, with its overhead trolley supported by truss extending full length of factory. Platforms, with pipe railing, are for men working on upper part of walls; open pits are provided for nailing of bottom part of panels.

Courtesy, Pease-Way Homes.

Flat roofs are likely to be of stress-covered panels, with plywood sheathing on top and Ply-wall on the bottom to serve as the ceiling.

Ceiling panels are also prefabricated, as described in the "DFP Construction Manual" in which case the plywood is nailed and glued to parallel 1"x2" ribs, 16" on centers. Panels are built up in full room size so that the joint between two such panels will occur at the center line of a partition.

Prefabricated floor panels are used to some extent, but in most cases are still experimental.

FRAMING:

Different prefabricators use different sizes of studs for walls and partitions, depending upon the panel construction.

If the plywood is nailed to the framing, studs are likely to be 2"x4", spaced 16" on centers. When panels are glued on, smaller studs are often used, down to 1"x3", spaced 12" on centers. This size reduction is a natural



Most prefabricating plants have spray booths or special paint departments for priming or finishing wall and ceiling sections. Wet weather is no obstacle for shop work.

Courtesy, National Homes Corporation.

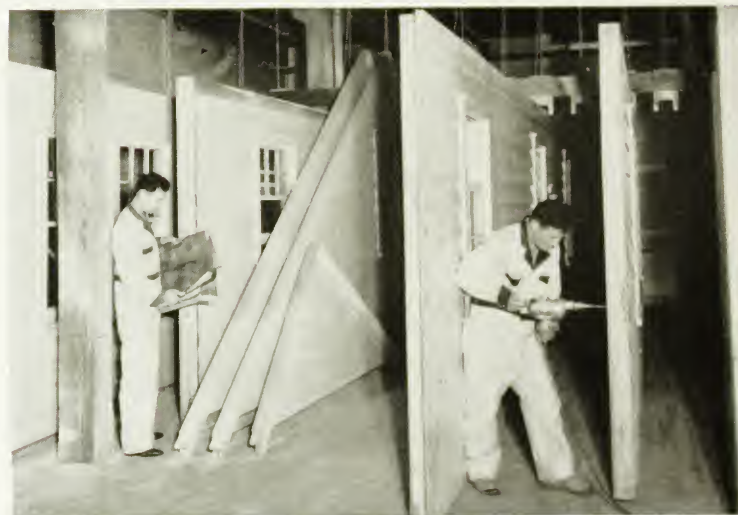


Spray booth in finishing department. Panels, after edges are machined, are butt-jointed in applying to frame. Here a natural finish is specified which in this case consists of coats of sealer, shellac, varnish.

Courtesy, Gorman Lbr. Sales Co.,
Oakland, Cal.
("Plywood Structures" System).



Finished wall panels, of different types, suspended from overhead trolley.
Courtesy, National Homes Corporation.



Painted wall length panels, complete with siding; windows are glazed.
Courtesy, Green's Ready Built Homes.



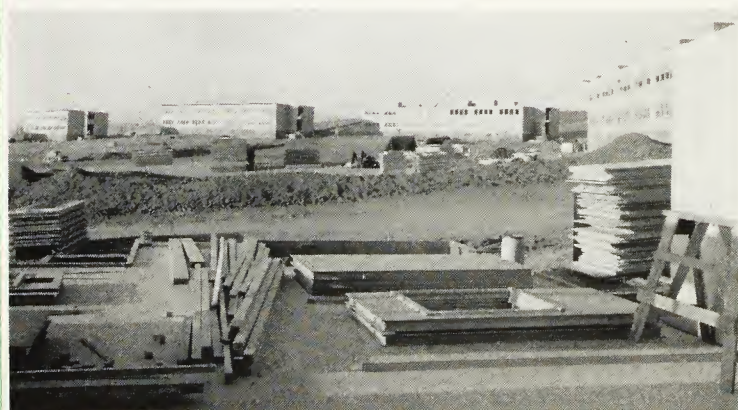
Prefabricated plywood units for the Farm Security Administration's well-planned and well-constructed Vallejo, California, housing project.
Courtesy, Plywood Structures.



Ready to start erection. The foundation has been built and floor joists and plywood subfloor laid while the wall sections were being fabricated in the shop. Within a few brief hours all walls and partitions, ceilings and roof panels will be permanently in place ready for finishing details.
Courtesy, I. F. Laucks (Speedwall Co.)



Here prefabricated floor panels are being unloaded and quickly placed, to reduce the time consumed by older, at-the-site assembly methods.
Courtesy, Green's Ready-Built Homes.



The two-story Prefabricated Plywood Barracks built during the summer of 1941, at Vallejo, California. Completed barracks in background.
Courtesy, Plywood Structures.



Open-air prefabrication for large West Coast Housing project. Roof panels are being assembled at central work-benches where nailing can be done conveniently and where the materials are always at hand.
Courtesy, E. K. Wood (Bates Prefabricated System).



Erecting a prefabricated door panel. Note floor plate over which panels are fitted to effect accurate alignment in setting walls.
Courtesy, Plywood Structures.

sequel to the adoption of stressed-covered construction, since the plywood helps to carry any load and more than compensates for the use of the lesser dimensions.

It is quite common practice to use headers or horizontal "nailing" strips between studs. Sometimes two or even three rows are inserted in the 8' panel height.

PANEL JOINTS:

When prefabricated wall units are built to full room length, several methods are employed to join the several 4'x8' plywood panels required.

Some use panels that have been scarf-jointed along the sides to produce any desired width or length up to 20' or more.

Others use a long plywood strip, nailed lightly to the stud under the joint, and glue the abutting panels to the strip. This also produces an excellent joint especially when formed with a hot-plate press.

Simple butted joints are also effective, it being common practice to machine the panel edges to produce a perfect fit. This type of joint is employed by many prefabricators using a standard 4'x8' unit construction, with panels tongue and grooved or with a splined joint.

REQUIREMENTS FOR PREFABRICATING:

Any good reputable builder can "prefabricate-with-plywood" the houses he would normally build and as a result develop new business as well.

Naturally a moderate amount of capital is needed (exact amount depending on size of operation planned), and suitable floor-space for the shop work planned. Extra space for expansion has been found necessary by a number of prefabricators, almost as soon as they've gotten well organized. Cramped quarters do not engender efficiency.

Shipping facilities for truck or rail deliveries, must be provided.

Most vital of all is the merchandising or distribution system for disposing of the products. The local builder, substituting prefabrication for slower, on-the-site construction, and confining his activities to the local market, is not faced with a serious merchandising problem. Adoption of these mass-production principles gives him a strong competitive sales advantage and protects him from outside encroachments.

The prefabricator, seeking distant markets and large volume production, however, must plan how and through what channels he will sell his prefabricated units and houses.



Raising prefabricated ceiling panel into position. The plywood is nailed to the 1"x3" ribs except at joints, where a long strip of plywood about 2 1/2" wide and 1/4" thick is nailed to the rib, and then the plywood panels are glued to this strip. A later technique calls for glueing several plywood panels together on long edges to form a sheet 8' wide and up to 16' or even 20' long. These panels are glued either by scarfing or by edge glueing with a long gusset or splice plate to back up the joint. The entire plywood sheet is then nailed to the stiffening ribs, and after installation, these ribs are side-nailed to ceiling joists.

Courtesy, Ramsey Lumber Co.



Unloading room-length prefabricated wall panels. Special iron hooks are used for lifting these units into place. Note the building paper and furring strips over Plyscord sheathing, ready for job-application of siding.

Courtesy, Pease-Way Homes.



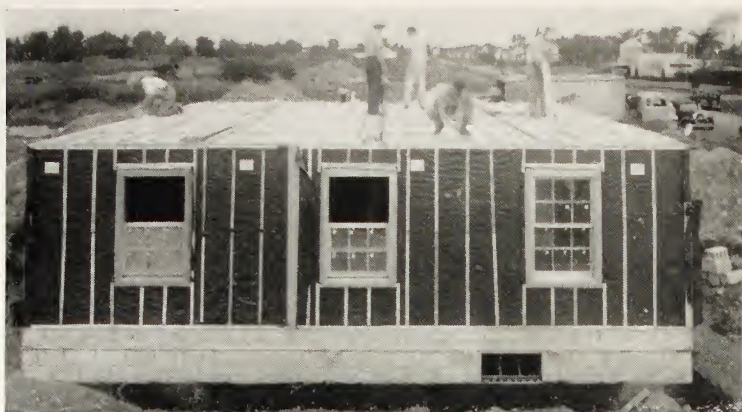
A tight corner is desirable in any house and is always a feature of good prefabrication. Note how one section squares up the other. Within a few hours all walls, partitions, ceilings, roof, etc., will be in place.

Courtesy, Pease-Way Homes.



Erecting prefabricated house illustrating Type C prefabricating method (see page 8). Note special panels for doors and windows which are joined to larger blank wall units and also to partition and built-in units.

Courtesy, I. F. Laucks (Speedwall Co.)



Walls and ceilings entirely prefabricated are in place, ready for roof joining. Note stiffening ribs, attached to top of ceiling panels in shop-jig; these ribs will now serve to align joists and be side-nailed to them.
Courtesy, Pease-Way Homes.



Prefabricated house, after walls and partitions have been erected and ceiling installed. Clip angles at corners are for possible demounting.
Courtesy, Johnson Lumber Co., Sharon, Pa.



Full sized plywood wall units, jointed only at corners and at interior partitions, are quickly erected. These panels have had lumber siding applied in the shop. In field erection this butts against vertical trim.
Courtesy, Green's Ready-Built Homes.

SHOP EQUIPMENT:

Local prefabrication, a possibility in practically every city in the country, can be done with a table saw, a portable electric saw, preferably also a small belt sander, and simple table jigs, into which pre-cut framing members are placed to receive the plywood coverings.

For large scale prefabrication, additional items may be desirable, such as a special hot press for making panel joints, an assembly line conveyor, and a spray booth for priming or finishing panels.

ORGANIZATION:

Small crews of well-trained men are being used successfully. Each factory or shop has its own



With walls, partitions, and ceilings in place, the builder installs the gable ends in single units. The rigidity of the Plyscord sheathing under the siding permits handling such sections without distortion or damage.
Courtesy, Green's Ready-Built Homes.

peculiar routine in which teamwork, accuracy and a sense of responsibility are important factors.

GENERAL:

Prefabricated plywood houses have been proved to be practical, economical, structurally sound and susceptible to best architectural treatment.

Ample variety of design and structure are possible even with assembly line production methods.

The development of this industry has been stimulated by the demand for low-cost housing and by emergency requirements, but with the "DFP Construction System" methods, freely available to any responsible builder, almost any type of house can be prefabricated.

The Federal Housing Administration has given blanket acceptance to a number of the large prefabricators. If a builder can demonstrate a sound design and proper workmanship in the shop and on the job, he will have little difficulty getting F.H.A. insured loans.

Prefabrication with Plywood presents an opportunity to the progressive, reliable organization. The field is wide open, the potentialities enormous. Who the leaders will be, only the future can determine.

Below—Plyscord sheathing is recognized by experienced builders as the ideal material. Greater rigidity, freedom from expansion and shrinkage, and excellent nailing properties are some benefits from using Plyscord.

Courtesy, Green's Ready-Built Homes.



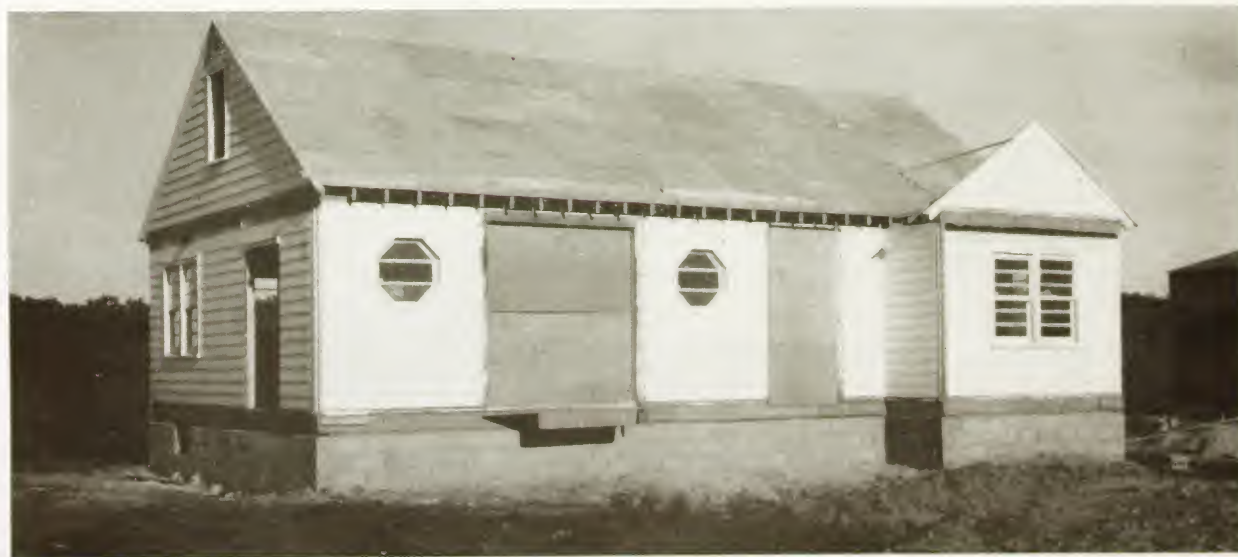
The next step is erecting the roof. In this instance, all rafters were shop cut. The 4' x 8' Plyscord roof sheathing is handled easily. A thousand square feet of plywood in place for five man hours is not unusual.

Courtesy, Pease-Way Homes.



Asphalt shingles being applied to Plyscord roof after felting. No wind can dislodge shingle nails in Plywood. The shingles themselves will be torn away first, indicating more than adequate nail holding power.

Courtesy, Pease-Way Homes.





Courtesy, National Homes, Inc.

